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Review of proposed Desalination Amendment

I have carefully read the draft Appendix A of the Desalination Amendment, the draft Staff Report on *Desalination Facility Intakes, Brine Discharges, and the Incorporation Of Other Nonsubstantive Changes,* and several supporting documents including the Roberts et al. (2012) panel report (SCCW report # 694) on *Management of Brine Discharges to Coastal Waters: Recommendations of a Science Advisory Panel,* the Phillips et al. (2012) study on *Hyper-saline Toxicity Thresholds for Nine California Ocean Plan Toxicity Test Protocols,* the Jenkins and Wasyl (2013) report on *Analytic Comparisons of Brine Discharges Strategies Relative to Recommendations of the SWRCB Brine Panel Report,* and the MIssimer et al. (2013) paper published in *Desalination,* vol. 322: 37-51. My review focuses on two major conclusions of the Desalination Amendment.

Conclusion #1. "A receiving water salinity limit of two parts per thousand (ppt) above natural background salinity is protective of marine communities and beneficial uses."

I do not think the scientific basis is sufficient to conclude that a salinity limit of two ppt is adequately protective. For the most part, a clear effort was made to use the best available science to support the new standards, and a good basis for this is provided by Roberts et al. (2012), Jenkins and Wasyl (2013), and Missimer et al. (2013). However, as noted by Roberts et al. (2012), the available relevant science is very limited, and several major data and knowledge gaps exist. Note that Roberts et al. (2012) emphasized a major limitation of the available science evidence: "a large proportion of the published work is descriptive and provides little quantitative data that can be assessed independently. Many monitoring studies lacked sufficient details of study design and statistical analyses, making interpretation of results difficult."They called for improved study and monitoring, noting further that "Such studies using robust experimental designs are currently underway in Australia (e.g., Perth and Sydney desalination plants) and are expected to substantially add to our understanding of field effects of desalination concentrate discharge. Detailed results from these studies are not yet available for review."This statement was written 2.5 years ago. Results may now be available. If so, they clearly would be immensely informative and should form part of the basis for the draft Staff Report and the draft new standards.

Several major issues somewhat undercut conclusion #1 as laid out in the draft Staff Report and the new standards. These include: 1) there is an over-reliance on short-term toxicity tests rather than more sensitive longer-term tests; 2) the additives used by desalinization plants (and therefore discharged with the brines) are not adequately considered (see Section 3.1, Chemical Additives, in Robertson et al. 2012 for a discussion on this point); and 3) no evidence is provided to support the conclusion that discharge of brines with comingled sewage, agricultural, or industrial wastes should be the preferred method of disposal, and I am not aware of any scientific evidence indicating this is in fact a desirable approach;

Specifically, I recommend:

•a greater reliance on longer-term chronic toxicity tests in evaluating discharge standards, and the use of tests with actual RO discharge rather than brines made from freezing seawater, where the potentially toxic additives used in RO operations are not present; such information is largely lacking now (Roberts et al. 2012), but its development should be explicitly encouraged; further, it should be noted that the current approach is likely to underestimate effects, and so the proposed brine discharge standard of 2 ppt above background salinities (page 40 of the draft Appendix A of the Desalination Amendment) may not be protective enough; a standard of 1 ppt should be considered, as is used by many agencies in Australia and Japan;

• consideration of a requirement that the chemical additives used by desalinization plants be publicly disclosed (according to Roberts et al. 2012, this is not currently the case, as proprietary business claims keep the list of additives a secret); the draft Appendix A of the Desalination Amendment is silent on this point;

• toxic substances, including those that are added by operators but also others such as copper which are known to be release from desalinization plants and may simply result from leaching of pipes and filters, should be explicitly considered in risk assessment of discharges, and monitored appropriately; the draft Appendix A of the Desalination Amendment is also silent on this point;

• consideration of requirements that would prohibit the use of some chemical additives (such as chlorine), and requirement of environmentally preferred alternatives (such as perhaps ozone); the draft Appendix A of the Desalination Amendment is silent on this as well;

• greater caution in urging the comingling of brine with sewage, agricultural, and industrial wastes as the preferred method of disposal, as on page 34 of the current draft Appendix A of the Desalination Amendment; there is no available science to conclude that this is in fact an environmentally safe alternative.

<u>Specific comments on the draft Staff Report regarding conclusion #1:</u>

Page 13, section 2.2: the report refers to the Phillips et al. (2012) study and states that effects were found at salinities just 2 to 4 ppt above ambient. While this is true, it is perhaps misleading. Phillips et al. (2012) themselves state "The whole effluent toxicity (WET) protocols used in the current research were designed to provide short-term indications of chronic toxicity. Because there is some concern over the chronic effects of brine effluent on marine receiving systems, longer-term chronic toxicity studies should be conducted to confirm the WET protocols are adequately protective of ocean receiving systems impacted by hypersalinity."I believe it likely that appropriate longer-term chronic toxicity may show effects at lower salinities. Further, as noted by Roberts et al. (2012), most of the experiments in the Phillips et al. (2012) study were with brine created by freezing seawater, and not actual brines from RO facilities, where the addition of biocides, etc., seem likely to increase the toxicity of the effluent.

Page 62, section 8.4.5: the report defines sensitive species as "organisms that can only survive within a narrow range of environmental conditions." I urge that a broader definition be used, one that would include species that are particularly vulnerable to anthropogenic stresses, such as from toxic substances, whether or not they have a narrow environmental range for survival.

Page 64, option 3: the report states "Desalination facilities could be sited at locations where subsurface intakes are infeasible as long as the regional water board determines it is otherwise the best site and in combination with the best design, technology and mitigation measures results in the least amount of marine life intake and mortality."Insufficient guidance is given as to how the regional water board would make such a determination in a scientifically defensible manner. Since subsurface intakes are clearly the best approach, again, why not simply require that desalinization plants be built only where subsurface intakes are feasible?

Page 64, option 3: the report claims "Siting a desalination facility in close proximity to a wastewater dilution source can prevent a facility from discharging toxic concentrations of brine into ocean waters." This over-states what is known. As Roberts et al. (2012) noted, there has been virtually no study of the effects of co-releasing brines with wastewater sources. Since wastewaters contain toxic materials, this blanket recommendation seems unwise without further study. One explicit conclusion of the Roberts et al. (2012) report states "When concentrate is blended with municipal wastewater, chemical/physical interactions of the concentrate with municipal wastewater constituents may produce toxic effects that cannot be detected using traditional WET test methods."

Pages 70-71, section 8.5.1.2: the report discusses the toxicity of brine, but does not state that toxic materials such as biocides used by desalinization plants are part of the brine discharge. This is an important point, and unfortunately very little is known about how this affects the overall toxicity of brine discharges (a point highlighted by Roberts et al. 2012).

Page 83, section 8.6.1: here, the report brings up the problems with relying on only short-term toxicity tests and the need to fully consider the toxic materials used by desalinization plants: "Most laboratory studies have focused on short-term chronic salinity toxicity associated with Whole Effluent Toxicity testing (WET), for which there is limited information on sub-lethal endpoints associated with reproduction, endocrine disruption, development, and behavior of benthic invertebrates and vertebrates. Additionally, existing WET studies have focused on the salinity of brine discharges, but have not addressed acute and chronic effects from different types of concentrates and mixtures of membrane treatment chemicals (antiscalants) associated with RO. (Roberts et al. 2012; Phillips et al. 2012) Antiscalants are typically used in desalinating seawater; however, chlorine or other chemicals may also be used at facilities to reduce biofouling (Roberts et al. 2012)." These are critically important points that need to much more fully inform the entire draft Staff Report, and the resulting recommendations. For instance, why allow the use of chlorine? Why not instead require the use of ozone, as is commonly done for many publicly owned sewage treatment plants because the discharge effluent is far less toxic?

Page 94, section 8.7.1: the report states "The Panel reviewed scientific literature that addressed impacts of elevated salinity on marine organisms and found that most marine organisms started to show signs of stress when salinity was elevated by 2 to 3 ppt…..", referring to the Roberts et al. (2012) report. This statement is true, but perhaps misleading since Roberts et al. (2012) also noted that this does not account well for the toxic substances used by desalinization plants, nor for the inherent insensitivity of short-term toxicity testing (a conclusion also of the Phillips et al. 2012 study). Table 2.1 in the Roberts et al. (2012) report shows that several authorities in Australia and Japan have limited brine discharges to an increase of 1 ppt. This should be explicitly acknowledged by the staff report.

Page 95, section 8.7.1: the report states "The Science Advisory Panel recommended that salinity vary by no more than five percent at the edge of the zone of initial dilution. For most California coastal waters, this translates to an increase of 1.7 ppt (rounded up, 2 ppt) above ambient background."To be protective, one should round 1.7 ppt down to 1.0 or 1.5 ppt, and not up to 2 ppt, particularly given the lack of longer-term chronic testing, etc.

Page 95, section 8.7.1: the report states “The Science Advisory Panel further recommended that the salinity objective should be based on the most conservative species. The reports by Phillips et al. (2012) and Roberts et al. (2012) provide the basis to develop a receiving water limit for California’s ocean waters. The Granite Canyon report showed that red abalone was most sensitive to elevated salinity, with an LOEC at 35.6 ppt. Since salinity toxicity studies were not done for all organisms in the California marine environment, the 2 ppt limit may be overly conservative for some species, but not conservative enough for others. However, the majority of the studies on elevated salinity showed that effects were not seen below 2 to 3 ppt above natural salinity (Roberts et al. 2012).”This does not acknowledge the caveat in the Phillips et al. (2012) study that the short-term toxicity testing may not be as sensitive as longer-term testing (see my comment above regarding page 13), nor the problem that the Phillips et al. (2012) experiments primarily used brine created by freezing seawater rather than RO effluent, where added biocides, etc., would contribute to the toxicity (see my comment above regarding pages 70-71).

Page 108, section 8.7.6: the report states “Staff recommends a combination of Option 4 and Option 6. The Ocean Plan should establish a narrative receiving water limit for salinity of 2 ppt above natural background, applied at a distance no greater than 100 meters from the point of discharge.” For the reasons I lay out above, 2 ppt may not be protective enough. The science is simple too uncertain, and has too many gaps, to reach this conclusion. A safer way forward would be to use the 1 ppt standard employed by many agencies in Australia and Japan, and the use high-quality monitoring to ensure that even this lower level is protective enough.

Conclusion #2. A subsurface seawater intake will minimize impingement and entrainment of marine life.

Conclusion #2 is very strongly supported by the scientific evidence, and the draft Staff Report does an excellent job of summarizing this science. However, despite this clear and strong evidence that the use of subsurface intakes are far less damaging ecologically than are surface intakes, the draft new standards allow surface intakes at the discretion of regional water boards. In light of these deficiencies, I am not convinced the new draft standards are sufficiently protective.

I recommend:

- a requirement that only subsurface intakes be used as sources of seawater, since the available science as presented in the draft Staff Report, Roberts et al. (2012), and Missimer et al. (2013) clearly indicates this is far more protective than the use of surface intakes; the draft Appendix A of the Desalination Amendment gives regional water boards the ability to allow surface intakes (pages 32 through 34)

<u>Specific comments on the draft Staff Report regarding conclusion #:</u>

Page 58, section 8.3.5: I disagree with the staff recommendation that surface intake of seawater should be allowed “if subsurface intakes are shown to be infeasible.”The preceding 14 pages of the draft Staff Report do an excellent job of outlining why subsurface intakes are far preferable from an environmental standpoint, as does the Roberts et al. (2012) report and the Missimer et al. (2013) paper. Option 2 is strongly supported by the available science, and the available science indicates that any use of surface intakes is very likely to increase ecological damage, both from entrainment and impingement and from the need to use more chemical additives which are then discharged with the brine effluent. Further, the draft Staff Report gives no guidance as to how to determine where subsurface intakes may be "infeasible."I recommend that new desalinization plants only be allowed where subsurface intakes can be used (or where desalination plants are co-located with once-through electric power generating facilities, as discussed on page 63).

Page 63, option 2: the report states "Option 2 would be environmentally protective but may be overly restrictive and could prevent some communities from being able to use desalination to augment their water supply. Subsurface intakes are not feasible at all locations, and there are only 13 power plants operating in California, including Diablo Canyon Nuclear Power Plant. "This presupposes that siting a desalination plant be determined by the wish of individual communities to have a plant in their own jurisdiction, rather than based on minimizing environmental harm. Why not allow desalination plants only in sites where ecological damage is minimal, with subsurface intakes required and brine discharges only into ecologically insensitive areas? Communities that do not have these attributes within their jurisdiction could ship in freshwater from other facilities (California has a long tradition of shipping water over long distances, when deemed necessary).

Page 65, section 8.5: the report again states "Desalination facilities with appropriately designed subsurface intakes can effectively eliminate impingement and entrainment of marine life, and consequently should not need to mitigate for intake-related mortality. However, subsurface intakes may not always be feasible."The best available science would dictate the exclusive use of subsurface intakes.